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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
WASHINGTON, D.C. 20546

REPLY TO  
ATTN OF: GP

November 6, 1970

TO: USI/Scientific & Technical Information Division  
Attention: Miss Winnie M. Morgan

FROM: GP/Office of Assistant General Counsel for  
Patent Matters

SUBJECT: Announcement of NASA-Owned U. S. Patents in STAR

In accordance with the procedures agreed upon by Code GP and Code USI, the attached NASA-owned U. S. Patent is being forwarded for abstracting and announcement in NASA STAR.

The following information is provided:

U. S. Patent No. : 3,509,578  
Government or  
Corporate Employee : U.S. Government  
Supplementary Corporate  
Source (if applicable) : NA  
NASA Patent Case No. : XKS-08485

NOTE - If this patent covers an invention made by a corporate employee of a NASA Contractor, the following is applicable:

Yes ☐

No ☒

Pursuant to Section 305(a) of the National Aeronautics and Space Act, the name of the Administrator of NASA appears on the first page of the patent; however, the name of the actual inventor (author) appears at the heading of Column No. 1 of the Specification, following the words "... with respect to an invention of

*Elizabeth A. Carter*  
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Enclosure

Copy of Patent cited above

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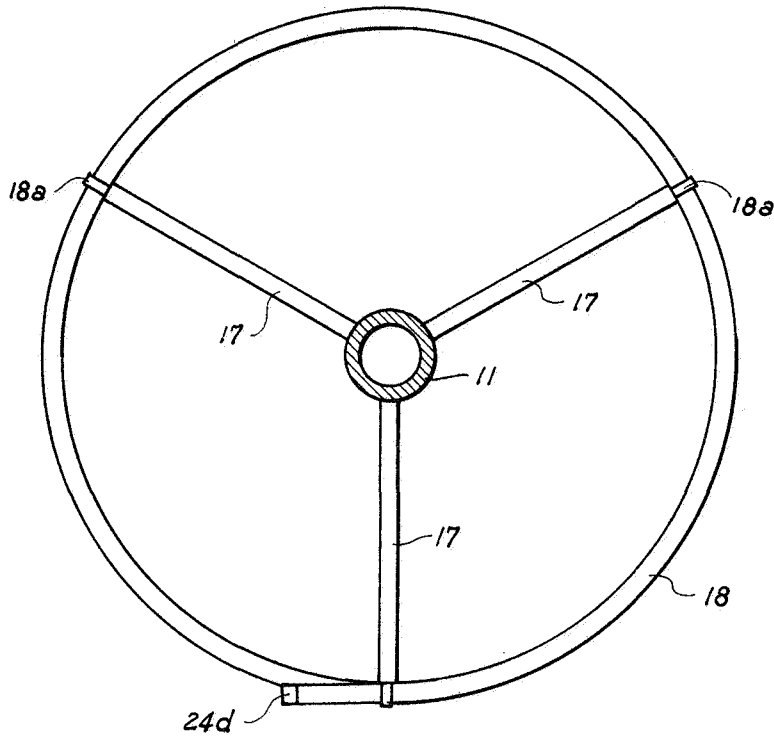
H. E. CRIBB

3,509,578

WEATHERPROOF HELIX ANTENNA

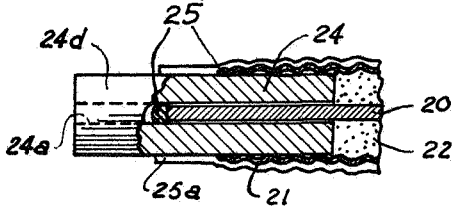
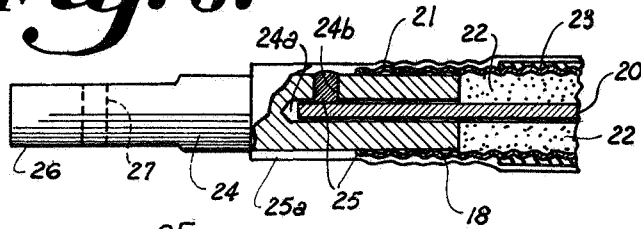
Filed June 21, 1967

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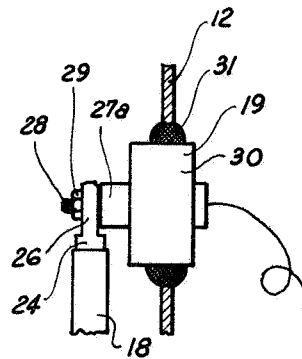


*Fig. 2.*

*Fig. 3.*



*Fig. 5.*



*Fig. 4.*

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3,509,578

## WEATHERPROOF HELIX ANTENNA

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3 Claims

### ABSTRACT OF THE DISCLOSURE

A helical antenna constructed of a flexible weatherproof cable which is flexible enough to be bent into the shape of a helix about standoff insulators, yet substantially rigid enough to retain such shape after so bending. The weatherproof helical antenna is movably mounted on a stand for appropriate orientation in any direction.

The invention described herein was made by an employee of the United States Government and may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to an antenna, and more particularly to a weatherproof helix antenna which can be utilized where corrosion is a major factor, such as at island and seacoast facilities, or on range tracking ships.

Heretofore, helical antennas constructed for use in installations where corrosion is a major factor, such as on island and seacoast facilities, or on range tracking ships, were very expensive. The antenna helix was formed from soft copper tubing using a mandrel to shape such. The mandrel had to be custom machined so that the copper tubing would stretch out to the proper helix diameter and pitch for the operating frequency of the antenna. Calculating mandrel dimensions and machining the mandrel on a lathe took many hours of a machinist's time. Furthermore, the copper tubing had to be weatherproofed by silver plating and painting it. Such antennas are very expensive plus, they required a considerable amount of maintenance in order to maintain them in the proper operating condition.

It is desired that a reliable, rugged, inexpensive and weatherproof antenna be utilized, which is capable of withstanding corrosive weather conditions, and can be constructed by relatively inexperienced personnel. Moreover, it is desired to provide an antenna which can be easily assembled so that such can be transported to a desired location unassembled. This is particularly important for use on range tracking ships which are strategically located at different locations for monitoring a space flight.

In accordance with the present invention, it has been found that the foregoing difficulties encountered in helical antennas may be overcome by providing a novel helix for the antennas. An antenna constructed in accordance with the present invention includes the following basic parts: (1) an elongated supporting shaft, (2) a plurality of circumferentially and longitudinally spaced standoff insulators extending radially from the supporting shaft, (3) the length of the standoff insulators determining the diameter of the helix and the orientation of the standoff insulators determining the pitch angle for the helix, (4) a base member carried adjacent one end of the supporting shaft, (5) a flexible cable having one end secured to the base member and being secured to the standoffs defining a helix, (6) the cable having a unitary elongated central conductor extending longitudinally therethrough, (7) an elongated unitary tubular conductor of a greater diameter than the central conductor encompassing the central conductor de-

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fining a space between the inner surface of the tubular conductor and the periphery of the central conductor, (8) a foam dielectric carried in the space between the central conductor and the tubular conductor permitting the cable to be flexible enough to be bent into a helix and rigid enough to hold the shape after bending, a non-metallic sheath carried on the outer surface of the tubular conductor weatherproofing such from the elements, and (10) an electrically conductive member carried adjacent each end of the cable for electrically connecting the tubular conductor to the central conductor.

Accordingly, it is an important object of the present invention to provide an inexpensive weatherproof helix antenna which requires a minimum amount of maintenance.

Another important object of the present invention is to provide an antenna which can be readily assembled by relatively inexperienced personnel.

Still another important object of the present invention is to provide a helical antenna in which the helix is formed from a cable having a central conductor encompassed by a tubular conductor with a foam dielectric interposed therebetween so that the cable is flexible enough to be bent into the proper shape and rigid enough to maintain the shape.

A further important object of the present invention is to provide a helical antenna which can be transported disassembled and subsequently readily assembled at a desired location.

Other objects and advantages of this invention will become more apparent from a reading of the following detailed description and appended claims taken in conjunction with the accompanying drawings wherein:

FIGURE 1 is a perspective view illustrating a helical antenna constructed in accordance with the present invention;

FIGURE 2 is an enlarged transverse sectional view taken along line 2—2 of FIGURE 1;

FIGURE 3 is an enlarged longitudinal sectional view illustrating the electrically conductive member carried adjacent one end of the helix for electrically connecting the tubular conductor to the central conductor;

FIGURE 4 is an enlarged fragmentary view, partially in section, illustrating the manner in which an electrical conductor passes through the base member; and

FIGURE 5 is an enlarged longitudinal sectional view illustrating the electrically conductive member carried adjacent the outer end of the helix for electrically connecting the tubular conductor to the central conductor.

Referring now in more detail to the drawings wherein like reference numerals designate identical or corresponding parts throughout the several views, and with special attention to FIGURE 1, reference numeral 10, generally designates a helical antenna in a horizontal position. The antenna includes an elongated metal supporting shaft 11. A base member 12 constructed of any suitable material, such as steel, is carried adjacent one end of the supporting shaft 11, and extends radially outwardly from the supporting shaft. The base plate 12 and the supporting shaft 11 are, in turn, secured to a supporting block 13 which is suitably mounted on a stand generally designated at 14. A counterbalanced weight 15 is mounted on one end of a horizontal shaft 16 which has its free-end secured by any suitable means to the supporting block 13. A plurality of circumferentially and longitudinally spaced standoff insulators 17 extend radially from the supporting shaft 11. The length of the standoff insulators determines the diameter of the helix and the orientation of the standoff insulators determine the pitch angle of such. The standoff insulators may be constructed of any suitable non-conductive material and secured to the supporting shaft by any suitable means, such as screwing

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them into threaded holes carried on the shaft. A flexible cable 18 has one end secured to the base member 12. The main body of the cable is secured to the standoffs 17 in any suitable manner to define a helix. It is noted that the end of the cable is insulated from the base member 12. One suitable means of securing the cable to the ends of the standoffs incorporates a pin 18a having a circular member adjacent one end through which the cable is threaded and a shank adjacent the other end, which is driven into the end of the wooden standoffs. Any suitable connecting means could be utilized. In securing or winding the cable on the standoffs 17 one end of such is coupled to the connector, generally designated at 19, and such is bent by hand so that it is wound onto the ends of the standoffs.

The cable 18 has a unitary elongated central copper conductor 20 extending longitudinally therethrough. An elongated corrugated tubular copper conductor 21 of greater diameter than the central conductor 20 encompasses the central conductor defining a space therebetween. A foam dielectric 22, such as foamed polyethylene, is carried in the space between the inner surface of the tubular conductor 21 and the central conductor 20 permitting the cable to be flexible enough to be bent into a helix and rigid enough to hold such shape after bending. A thermoplastic coating or sheath 23 is carried on the outer surface of the tubular conductor 21 waterproofing such from the elements. One suitable cable which has been used to form the helix is manufactured by Andrew Corporation of Los Angeles, Calif., and has a Model No. FHJ4-50A.

An elongated electrically conductive shorting member 24 is carried adjacent the inner end of the cable 18 for electrically connecting the tubular conductor 21 to the central conductor 20. The shorting member 24 has a drilled axial bore 24a which receives the end portion of the central conductor 20. A lateral bore 24b is also drilled in the shorting member 24 and communicates with the axial bore 24a so that solder can be poured therein. The solder secures the end portion of the central conductor within the drilled axial bore 24a. The copper tubular member 21 also extends over a portion of the shorting member 24 and is soldered thereto by bead 25. In preparing the cable 18 so that the shorting member 24 can be mounted thereon, first the tubular member 21 and the foam dielectric 22 are stripped off to expose the end portion of the central conductor 20. Then a sufficient amount of the foam dielectric 22 is removed permitting a portion of the shorting member to be inserted within the tubular copper member 21. It is noted that the exposed end of the central conductor 20 is inserted within the axial bore 24a. Solder 25 is then poured within the lateral bore 24b and flows through the axial bore 24a securing the end portion of the central conductor 20 within the drilled bore 24a upon cooling. When the shorting member is soldered between the tubular conductor 21 and the central conductor 20 such provides a good electrical connection therebetween. Weatherproof adhesive tape 25a is wound around the end of the cable 18 and the shorting member 24 for securing such together. The shorting member has a flat reduced end 26 with a hole 27 extending therethrough so that such can be bolted to the connector 19 carried within the base plate 12. The connector has a central conductive portion 27a which is secured to the shorting member by means of a reduced threaded shank 28 which extends through the hole 27 in the shorting member. A nut 29 secures the shorting member 24 onto the shank 28. The conductive portion 27a extends through a main body portion 30 which is secured within the base plate 12 by any suitable means, and is insulated therefrom by insulating material such as rubber 31. Any suitable connecting element could be utilized.

The shorting member 24d which is illustrated in FIGURE 5 is provided for shorting the free-end of the helical cable and is identical with the construction of that of the

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shorting member 24 with the exception that no connecting portion is carried adjacent the end. The cable 18 is stripped in the above-mentioned manner, and the longitudinal axial bore 24a slips over the central conductor 20 and solder is poured in the end of the axial bore 24a securing the cable to the shorting element 24d. The tubular 21 is then soldered to the shorting element 24d by means of a bead 25. Weatherproof adhesive tape 25a is then wound around the end of the cable and the shorting member 24a.

As previously mentioned, the supporting block is mounted on a suitable stand 14 so that the antenna can be rotated and pivoted vertically. The supporting block 13 is carried on a horizontal plate 32 which is, in turn, mounted in a pivotable manner (not shown) on the top of shaft 33 so that the antenna can be pivoted in a vertical direction. A side plate 34 extends downwardly from the horizontal plate 32 and has an arcuate shaped slot 35 therein through which a locking nut 36 extends. The locking nut 36 engages the shaft 33 so that when such is drawn downward it locks the side 34 in a fixed position. The shaft 33 is allowed to rotate in sleeves 37 carried adjacent the bottom of the supporting frame. Legs 38 extend outwardly from the sleeves for supporting such. A locking screw member 39 is carried on the upper sleeve 37 so that when such is rotated in one direction it locks the shaft 33 in a fixed position so that it cannot rotate.

Since the helix of the antenna is made from a corrosion proof dielectric helix-type transmission line that has been shorted out at each end, very little maintenance is necessary for such. The foam dielectric transmission line is flexible enough so that it can be bent or oriented around the standoff insulators 17 by a relatively inexperienced person to form the desired helix. Since the helix can be formed with relative ease, the antenna can be transported in a disassembled manner and assembled at the desired location.

While a preferred embodiment of the invention has been described using specific terms, such description is for illustrative purposes only, and it is to be understood that changes and variations may be made without departing from the spirit or scope of the following claims.

What is claimed is:

1. A weatherproof helical antenna comprising:

(A) an elongated supporting shaft;

(B) a plurality of circumferentially and longitudinally spaced standoff insulators extending radially from said supporting shaft;

(C) said standoffs being of a predetermined length for defining the diameter of said helical antenna;

(D) a base member carried adjacent one end of said supporting shaft;

(E) a flexible cable having one end secured to said base member and being secured to said standoffs defining a helix;

(F) said cable having a unitary elongated central conductor extending longitudinally therethrough;

(G) a unitary elongated tubular conductor of a greater diameter than said central conductor encompassing said central conductor defining a space between the inner surface of said tubular conductor and the periphery of said central conductor;

(H) a foam dielectric carried in said space between said central conductor and said tubular conductor permitting said cable to be flexible enough to be bent into a helix and rigid enough to hold such shape after bending;

(I) a non-metallic sheath carried on the outer surface of said tubular conductor waterproofing such from the elements; and

(J) an electrically conductive member carried adjacent each end of said cable for electrically connecting said tubular conductor to said central conductor.

2. The helical antenna as set forth in claim 1 further comprising:

(A) a stand for supporting said antenna permitting such to rotate and pivot vertically.

3. The helical antenna as set forth in claim 1 wherein: 5

(A) said electrically conductive member has an axial bore for receiving said central conductor; and

(B) solder securing said central conductor to the walls of said bore providing electrical connection there- 10  
between.

# References Cited

## UNITED STATES PATENTS

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ELI LIEBERMAN, Primary Examiner

U.S. Cl. X.R.

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